

# A Plan for Recovery of the Lake Sturgeon in Missouri



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## EXECUTIVE SUMMARY

The mission of the lake sturgeon recovery program is to improve populations of a state endangered species, and increase the sturgeon's numbers sufficiently to provide a unique sport fishing opportunity to Missouri anglers. The goals, objectives, and strategies outlined in this plan provide a framework to guide Missouri's lake sturgeon management and culture efforts. This plan also serves as a tool to help communicate recovery program direction to anglers.

During the late 1800s, lake sturgeon populations in the Mississippi and Missouri rivers were severely depleted by commercial overharvest, pollution, and habitat degradation and were deemed incapable of recovery through the mid-1900s. Infrequent captures by fisheries managers and commercial fishers suggested that natural reproduction was either lacking or recruitment was too low to sustain the populations.

Designation of lake sturgeon as a Missouri endangered species in 1974, improvements in water quality following passage of the Clean Water Act of 1977, and federal interest in restoring degraded fisheries habitat in the Mississippi and Missouri rivers in the 1980s prompted the Missouri Department of Conservation to attempt to restore viable lake sturgeon populations in the big rivers using hatchery-raised fingerlings. Availability of fertile eggs from the Wisconsin Department of Natural Resources, refinement of culture techniques at Missouri's Blind Pony Hatchery, and more frequent reports of lake sturgeon captures by fisheries managers and commercial fishers encouraged the Department to prepare a 10-year "Plan for the Recovery of Lake Sturgeon in Missouri", which was finished in 1992. This plan is an update and revision of the original, incorporating new information and experience.

This revised plan contains the following goals and objectives:

**Goal 1:** Establish a self-sustaining population of lake sturgeon in the Mississippi and Missouri rivers.



Objective 1.1: Establish a population of lake sturgeon in the Mississippi and Missouri rivers by continuing stocking through 2016.



Objective 1.2: Characterize and quantify lake sturgeon habitat in the Mississippi and Missouri rivers and selected tributary streams and recommend measures to protect and improve it by 2009.



Objective 1.3: Develop methods for describing a desirable lake sturgeon population in the Mississippi and Missouri rivers by 2011.

**Goal 2:** Ensure public understanding of, appreciation of, and cooperation with the lake sturgeon recovery effort.



Objective 2.1: Secure support and coordination of other resource agencies within the Mississippi River Basin.



Objective 2.2: Encourage proper identification of lake sturgeon by commercial fishers and their reporting of lake sturgeon caught and released.

**Goal 3:** Establish a lake sturgeon population that can support a unique sport fishing opportunity.



Objective 3.1: Manage the lake sturgeon population with the intent to delist it as a state endangered species with evidence of adequate recruitment and when 15-20% of the population is 50 inches or longer.



Objective 3.2: Inform Missouri's big river anglers of recovery efforts and promote the lake sturgeon's unique sportfishing potential.

## FOREWORD

This plan for recovering the lake sturgeon resource in Missouri was a team effort using the wide array of expertise available in the Missouri Department of Conservation and nationwide. Ken Brummett, retired Fisheries Management Biologist, was chairman of the committee and contributed extensively to the revised plan. The following Department employees provided input as committee members or reviewers of this document:

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Gene Lindsey - Protection  
Rick Thom - Wildlife

This plan provides guidance for the Department's lake sturgeon recovery efforts for the next ten years. It will be reviewed annually and implementation will be directed by annual operational plans that consider current priorities and availability of funds and staff. This plan will be reviewed and updated as needed at the end of its 10-year term.

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## I. INTRODUCTION

### Background

Lake sturgeon (*Acipenser fulvescens*) are widely distributed in North America, and are found in three drainages: the Mississippi River, the Great Lakes, the Hudson Bay (Priegel and Wirth 1977; Harkness and Dymond 1961). This large, primitive, freshwater fish occurs in greatest abundance in large lakes and rivers of the Great Lakes region of the United States and Canada, but most of its range in the United States is in the Mississippi River Basin from the upper Mississippi River and its major tributaries to the southern border of Arkansas. Lake sturgeon in Missouri historically occurred in the Mississippi, Missouri, and lower Osage rivers.

Lake sturgeon were important commercial fish in the Great Lakes region and the upper Mississippi River during the late 1800s. Most were processed as smoked sturgeon, caviar, isinglass (swim bladder collagen) and fish oil. However, because of the large market for sturgeon flesh, they were soon over-exploited (Priegel and Wirth 1977). Man's mismanagement of the fish and its environment has reduced populations over most of its native range. For example, the Lake Erie sturgeon catch declined 80%, from over 5,000,000 pounds to less than 1,000,000 pounds between 1885 and 1895 (Harkness and Dymond 1961). In Lake of the Woods, harvest declined 90% in 7 years (1893-1900). Statistics compiled by the United States Fish Commission for 1899 show that in Missouri, 50,000 pounds of lake sturgeon were harvested commercially from the Missouri and Mississippi rivers in 1895. Lake sturgeon abundance has been low since the turn of the century. Commercial harvest of lake sturgeon has been non-existent since at least 1931 for the Mississippi River in Missouri, Iowa, and Illinois (Barnickol and Starrett 1951). In 1974, they were classified as endangered in Missouri.

Lake sturgeon have the potential to be a most unusual big game fish. Lake sturgeon can live up to 150 years, reach eight feet in length and a weight of 300 pounds. Missouri pole-and line anglers occasionally report catching 50-pound lake sturgeon after prolonged fights. Anglers travel long distances to fish for eight to 12 foot long white sturgeon in the Columbia River system in Idaho, Oregon, and Washington. A lake sturgeon fishery in Missouri has a similar potential.

Lake sturgeon feed on the bottom. Their diet consists primarily of larval aquatic insects, crayfish, snails, small clams, and small fish. As lake sturgeon grow larger, their dependency on small fish for food increases. However, lake sturgeon can also be scavengers and are often caught by catfish anglers using worms or cut bait. Lake sturgeon grow and mature slowly. It takes four to five years for a lake sturgeon to reach a length of 20 inches and a weight of one pound. It takes 20 years before a lake sturgeon can spawn for the first time. By then the fish are 48 inches long and weigh 20 - 30 pounds (Pflieger 1997).

Relatively slow growth, relatively high age at spawning, inconsistent spawning (a female lake sturgeon only spawns once every three to five years), degraded water quality conditions throughout its range, and construction of dams on major rivers for navigation and hydropower have combined with overexploitation to reduce abundance of lake sturgeon in all but a few portions of its historic range.

Although lake sturgeon populations have declined over much of their range, there is evidence that populations can increase when there are sufficient numbers of mature fish and adequate habitat. Abundance of lake sturgeon in Wisconsin's Lake Winnebago system was stable during the 1930s and 1940s but increased after property owners began armoring river banks with large

rock in the 1950s to reduce erosion (Folz and Meyers 1985). Spawning sites on the Wolf River alone increased from 7 to 50 since the mid-50s (personal communications, Dan Folz, 1990). Identification of sites meeting minimal criteria for spawning and enhancing sites that are currently marginal can increase opportunities for successful recruitment of lake sturgeon.

#### Status of the Lake Sturgeon in Missouri

Carlson and Pflieger (1981) reported that lake sturgeon in Missouri have probably undergone a more drastic decline than shovelnose sturgeon (*Scaphirhynchus platyrhynchus*) or pallid sturgeon (*Scaphirhynchus albus*) and were the rarest of the three sturgeon. Infrequent catches by commercial fishers for the nearly 25 years preceding initiation of Missouri's reintroduction program indicate that the lake sturgeon population in Missouri's big rivers was extremely low (personal communication, John Robinson, 1991; Pflieger, 1997). Only occasional adults were caught in the Mississippi and Missouri rivers, indicating that natural reproduction was either non-existent in Missouri or survival of young was not sufficient to increase population numbers. Pflieger (1997) reported that before Bagnell Dam impounded the Osage River in 1931, lake sturgeon were often caught in the lower portion of that stream.

Rearing and releasing eight- to 10-inch lake sturgeon into Pool 24 of the upper Mississippi River and at several locations on the Missouri River over a long period was a strategy of the Missouri Department of Conservation to establish at least ten year classes in Missouri's large rivers. Actual releases of hatchery-reared 2- to 10-inch lake sturgeon began in Missouri waters in 1984 and have continued every year that fertilized eggs were available and hatchery water supply was sufficient. There are approximately 191,612 acres of open water on the upper Mississippi River pools below Lock and Dam 19, the open river to the mouth of the Ohio River, and the Missouri River within the boundaries of Missouri (Theiling, et al. 2000). As of fall 2005, only about 1.3 lake sturgeon per acre have been stocked into those waters (Mark Twain Lake stockings are excluded). The stocking strategy in the 1992 Lake Sturgeon Reintroduction Plan was for two fish per acre in the Mississippi River pools and 1.5 fish per acre in the Missouri River. The unimpounded portion of the Mississippi River was not included in that strategy.

Based on anecdotal information and netting surveys, the reintroduction efforts have been successful to the extent that encounters with lake sturgeon are more frequent than prior to our stockings. Encounters with lake sturgeon up to 80 pounds are being reported by fisheries biologists, commercial fishermen, and recreational anglers from Pool 20 below Keokuk, Iowa on the Mississippi River downstream to Chester, Illinois, and up the Missouri River to the tailwaters of Gavins Point Dam at Yankton, South Dakota. Gavins Point Dam is a complete barrier to fish migration and Lock and Dam 19, because of its hydropower function, is a nearly complete barrier (Wilcox, et al. 2004). In addition to the two big rivers, lake sturgeon catches have been reported from the larger tributaries in Missouri, Nebraska, and Illinois. Some biologists working Missouri's large rivers now sample over 100 lake sturgeon a year.

Despite the minor success with reintroduction efforts, the lake sturgeon population is not yet self-sustaining. Illegal harvest and mortality due to boat propeller injuries, entanglement in commercial nets, and handling stress by recreational and commercial fishers also need to be taken into consideration when assessing population status.

## Purpose of the Plan

The purpose of the 1992 10-year plan (*A Plan for Recovery of the Lake Sturgeon in Missouri*) was to guide decisions by fishery administrators and managers in the reestablishment and management of the lake sturgeon population in the Mississippi and Missouri rivers in Missouri (Missouri Department of Conservation 1992). That plan outlined objectives, strategies, and tasks for reestablishing lake sturgeon in those rivers, and provided for evaluating the program in 10 years. The hope was that stocked fish would ultimately provide a self-sustaining population of lake sturgeon capable of supporting a limited sport fishery. It was known the primary goal would not be met in 10 years because lake sturgeon do not mature until nearly 20 years of age. However, at the end of the 10-year period, the plan provided for assessing our accomplishments, determining the status of the program and making appropriate adjustments. This updated plan contains objectives, strategies, and tasks for reestablishing the lake sturgeon population in the big rivers and evaluating the program for the next 10 years. It also gives direction for evaluating existing habitat critical to all life stages and implementing measures to increase the extent of that habitat in the same 10 year period.

Although initiated in the 1990s, this work is consistent with the recently published MDC guiding document, *The Next Generation of Conservation* (Missouri Department of Conservation 2006). Implementation of this plan will address the first goal which is conserving plants, animals and their habitats. If we are successful and can create a self-sustaining population of lake sturgeon, it could be one of the five state endangered species the Department delists by 2015.

## **II. REINTRODUCTION – Past Efforts and Future Plans**

### Progress to Date

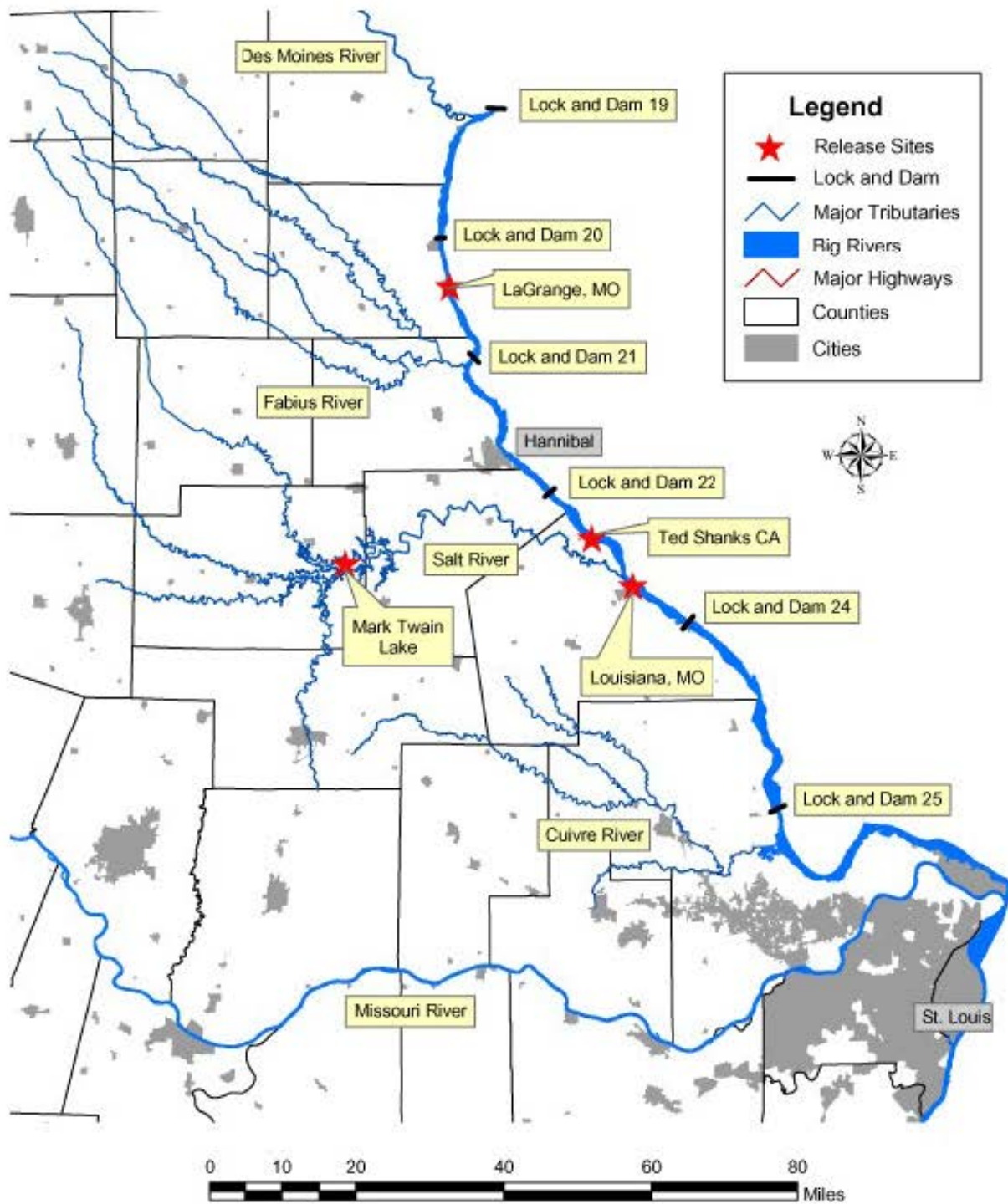
The Missouri Department of Conservation began obtaining fertilized lake sturgeon eggs from the Wisconsin Department of Natural Resources in 1983 to determine if lake sturgeon could be successfully reared in a Missouri hatchery. In August 1984, nearly 11,000, 2- to 4-inch lake sturgeon were reared and released into Mark Twain Lake, a new Corps of Engineers reservoir on Salt River, a tributary to Pool 24 of the Upper Mississippi River (Figure 1, Table 1).

Mark Twain Lake was chosen because it was new, had recently filled, had a relatively small predator population, likely had an abundant benthic invertebrate food base, and it was fairly turbid--conditions we believed would maximize survival. A second effort in 1986 resulted in about 11,000, 6- to 8-inch lake sturgeon being stocked. In late 1986, commercial fishers began to report catches of small lake sturgeon in Pool 24 of the upper Mississippi River. We believe many lake sturgeon migrated through the dam, via the turbines or over the spillway in releases that were made from 1984 to 1986 when lake conditions required that water be evacuated. No lake sturgeon have been sampled from Mark Twain Lake; however, we have an unconfirmed report of an angler catching and releasing a 12-inch lake sturgeon in 1986 and a report of a dead lake sturgeon about 24 inches long found in 1991.

The availability of fertilized eggs from Wisconsin, the ability of Missouri's Blind Pony Hatchery to raise them to 8 inches in one season, and a desire to restore a state endangered species to Missouri's big rivers prompted the Department to continue the stocking effort. One release site on the Mississippi River (Pool 24 at Louisiana; Figure 1) and several sites on the Missouri River (Washington, Hermann, New Haven, and Waverly) were selected initially (Figure 2).



Figure 1. Lake sturgeon release sites on the Mississippi River.



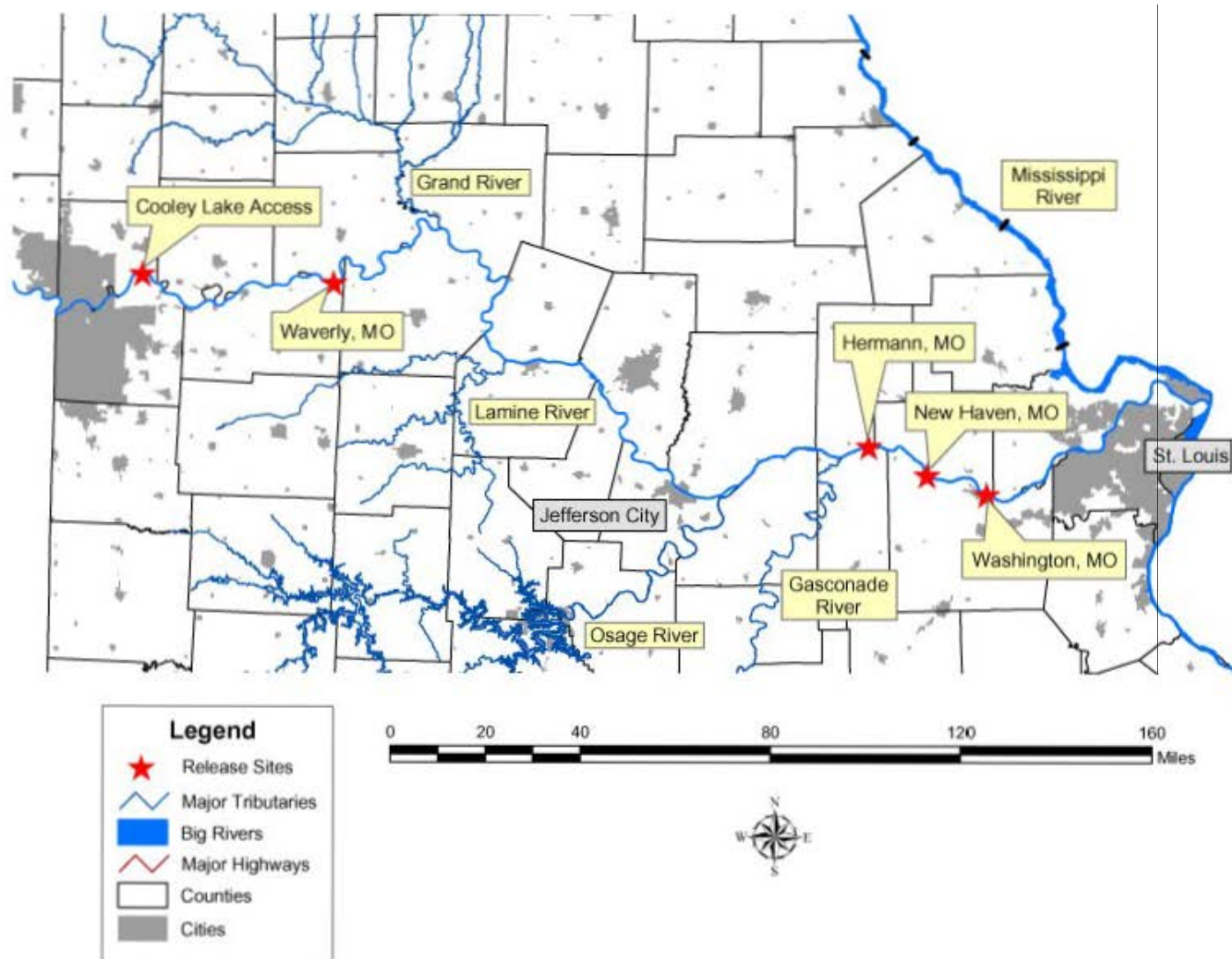


<b>Table 1. Lake Sturgeon Stocking in Mark Twain Lake, Missouri</b>					
Year of stocking	Date of stocking	Number of fish stocked	Length of fish stocked (inches)	Mark or tag and location	Hatchery where reared
1984	8/7/84 8/24/84	10,732	2-4	none	Blind Pony MDC
1984	11/21/84	1,447	8-10	none	Blind Pony MDC
1985	NA	373	6-8	none	Blind Pony MDC
1986	9/11/86 9/24/86 10/03/86	10,763	6-8	none	Blind Pony MDC
2001	5/22/01	9,504	1-2	none	Blind Pony MDC
Total		32,819			

<b>Table 2. Lake Sturgeon Stocking in the Mississippi River, Missouri</b>						
Year of stocking	Date of stocking	Location of stocking	Number of fish stocked	Length of fish stocked (inches)	Mark or tag and location	Hatchery where reared
1988	9/02/88	Pool 24 at Louisiana	9,503	8-10	Rt pelvic fin clip	Blind Pony MDC
1990	9/21/90 10/12/90	Pool 24 at Louisiana	11,000	8-10	Lft pelvic fin clip	Blind Pony MDC
1991	9/06/91	Pool 24 at Louisiana	15,103	8-10	CWT* in snout	Blind Pony MDC
1992	9/02/92	Pool 24 at Louisiana	11,036	8-10	none	Blind Pony MDC
1993	9/29/93	Pool 24 at Louisiana	7,975	8-10	none	Blind Pony MDC
1994	9/29/94	Pool 24 at Louisiana	10,440	8-10	CWT in dorsal scute and double t-bar anchor tag in pectoral fin	Blind Pony MDC
1995	10/11/95	Pool 24 at Louisiana	10,000	8-10	CWT in dorsal scute	Blind Pony MDC
1996	9/26/96	Pool 24 at Louisiana	9,012	8-10	CWT in dorsal scute	Blind Pony MDC
2001	5/22/01	In wetland pool at Shanks CA	10,017	1-2	none	Blind Pony MDC
	10/05/01	Pool 24 at Louisiana	10,000	8-10	CWT in dorsal scute	
2002	7/15/02	Pool 24 at Louisiana	700	5-10	CWT in snout	Upper Midwest Environmental Science Center
	7/15/02	Pool 24 at Louisiana	400	8-14	CWT in posterior scute	
	9/19/02	Pool 24 at Louisiana	8,754	6.6 avg	CWT in second dorsal scute	Genoa National Fish Hatchery
2003	9/17/03	Pool 24 at Louisiana	3,850	< 8	CWT in fourth dorsal scute	Genoa National Fish Hatchery
	9/17/03	Pool 21 at LaGrange	3,850	< 8	CWT in fourth dorsal scute	
2004	9/22/04	Pool 24 at Louisiana	3,668	6.1 avg	CWT in third dorsal scute on right side	Genoa National Fish Hatchery
	9/22/04	Pool 21 at LaGrange	3,667	6.1 avg		
2005	9/2/05	Pool 24 at Louisiana	2,333	5.4 avg	CWT in third dorsal scute	Genoa National Fish Hatchery
	9/2/05	Pool 21 at LaGrange	2,334	5.4 avg		
2006	9/8/06	Pool 24 at Louisiana	2,808	7.0 avg	CWT in first dorsal scute (43-01-55)	Genoa National Fish Hatchery
	9/8/06	Pool 21 at LaGrange	2,808	7.0 avg		
Total			139,258			

\*CWT= coded wire tag

Figure 2. Lake sturgeon release sites on the Missouri River.



In 1988, 9,500 8- to 10-inch lake sturgeon were released at Louisiana (Table 2). The first significant stocking of the Missouri River, 11,279, 1- to 2-inch fish, was in 1992 (Table 3).

<b>Table 3. Lake Sturgeon Stocking in the Missouri River, Missouri</b>											
	Washington		New Haven		Hermann		Waverly		Cooley Lake Access		Mark or tag and location
Date	Number	Size (in.)	Number	Size (in.)	Number	Size (in.)	Number	Size (in.)	Number	Size (in.)	
6/30/92	3,760	1-2	3,760	1-2	3,759	1-2					none
5/28/93	3,190	1-2	3,190	1-2	3,190	1-2					none
6/23/93					4,769	1-2					none
9/30/94					10,646	8-10					CWT* in dorsal scute and double t-bar anchor tag in pectoral fin
6/1/95					14,696	1-2					none
10/12/95			10,000	8-10			15,164	8-10			CWT in dorsal scute
9/27/96					4,462	8-10	4,263	8-10			CWT in dorsal scute
7/26/01					6,148	4-6			6,360	4-6	none
10/5/01					7,455	8-10					CWT in dorsal scute
9/2/05	2,333	5.4 avg	2,333	5.4 avg	4,667	5.4 avg					CWT in third dorsal scute
9/8/06	1,300	7.0 avg	1,300	7.0 avg	1,300	7.0 avg	1,300	7.0 avg			CWT in first dorsal scute (43-01-55)
Totals	10,583		20,583		61,092		20,727		6,360		

A total of 119,345 lake sturgeon have been stocked into the Missouri River. \*CWT= coded wire tag

The initial plan for reintroduction of lake sturgeon was approved in 1992 (Missouri Department of Conservation 1992), several years after the first stockings. Objective 1.1 of the plan was “to establish a population of lake sturgeon in the Mississippi and Missouri rivers comprised of 10 year classes by 2001”. That objective was achieved for Pool 24 (Louisiana) in 2002. We selected LaGrange, Missouri, in Pool 21 as the additional Mississippi River stocking site in 2003 because of its proximity to several side channels and connected backwater lakes.

In 2001, we had excellent survival of lake sturgeon from the fertilized eggs provided by the Wisconsin Department of Natural Resources. When production exceeded MDC hatchery space, we stocked 10,017 lake sturgeon 1 to 2 inches long in a wetland pool on the Ted Shanks Conservation Area. The wetland pool is connected to the Mississippi River during floods. Later in 2001 when production again exceeded hatchery space, 6,360 4- to 6-inch lake sturgeon were stocked into the Missouri River at the Cooley Lake Access in Clay County.

As of October 1, 2006, at least 258,603 lake sturgeon had been stocked into the upper Mississippi River and the Missouri River sites. Fish from the first two stockings were marked with a pelvic fin clip. Since that time, the fish have been either untagged, had a Floy tag inserted in their pectoral fin, or had a coded wire tag implanted in their snout or dorsal scutes. Lake sturgeon captured during netting surveys are checked for an implanted tag or other marking. Future stocking efforts will depend on strong partnerships with the Wisconsin Department of Natural Resources and the Genoa Federal Fish Hatchery, U.S. Fish and Wildlife Service.

This updated plan contains objectives, strategies, and tasks for reestablishing the lake sturgeon populations in the big rivers and evaluating those populations. It also gives direction for evaluating existing habitat critical to all life stages, implementing measures to increase the habitat, and for increasing stakeholder and general awareness.

### III. GOALS AND OBJECTIVES

**GOAL 1: Establish a self-sustaining population of lake sturgeon in the Mississippi and Missouri rivers.**

**Objective 1.1: Establish a population of lake sturgeon in the Mississippi and Missouri rivers by continuing stocking through 2016.**

Rationale: Prior to our stocking program, lake sturgeon were rare in Missouri for nearly 100 years, and it was believed that numbers were too few to establish a significant, viable, self sustaining population in the foreseeable future. We do not know the survival rate of stocked fish, but based upon the numbers of lake sturgeon reported by fisheries biologists, recreational and commercial fishers, we believe survival has been substantial.

The Wisconsin Department of Natural Resources has a lake sturgeon restoration program underway concurrent with the Missouri program (Wisconsin Department of Natural Resources 2004). Restoration efforts by Runstrom *et al.* 2002 suggest a desired stocking density of eight- to 10-inch fish at 3.7/lake surface acre/year for 25 years (cumulative stocking density of 92.5 fish/acre). Twenty-five years is recommended because it represents one generation of lake sturgeon. The Wisconsin lake sturgeon management plan (Wisconsin Department of Natural Resources 2004) recommends an annual stocking of 0.5 fingerlings/acre/year occur for at least 25 years. This results in a cumulative stocking density of 12.5 fish per acre.

Our past level of stocking does not meet the densities recommended. To achieve a cumulative stocking density of 12.5 lake sturgeon/acre in Missouri's portion of the Missouri and Mississippi rivers (191,612 surface acres), we would need to stock 2,147,350 additional fingerlings by 2013.

Due to limitations of the brood stock supply and state and federal hatchery capabilities, we can only expect to stock 20,000 to 24,000 per year in a good year.

The Pool 24 site was selected because of a reported high benthic invertebrate population and fairly stable substrate. We selected LaGrange, Missouri, in Pool 21, as the additional Mississippi River stocking site in 2003 because of its proximity to several side channels and connected backwater lakes. The four stocking locations on the Missouri River (in the vicinities of Washington, Hermann, New Haven, and Waverly) were selected because deep water overwintering, shallow water nursery and spawning habitats were present. Also the more stable substrates in these areas were expected to support many aquatic insects. None of the Missouri River stocking sites are in the sturgeon refuge established near the mouth of the Osage. We feel that because lake sturgeon are highly mobile, they will make their way to the refuge area if it is as attractive to lake sturgeon as it is to shovelnose and pallid sturgeon before they will be vulnerable to accidental commercial harvest.

Stocking will continue at the previously established sites, except one, because of the high quality and diverse habitats present. New Haven will be discontinued to ease delivery logistics. We assume the fish will disperse as they mature based on evidence that shows the lake sturgeon are very mobile and some individuals will disperse from the area where they were stocked. Some of the evidence includes: the movement of juvenile lake sturgeon out of Mark Twain Lake; the lake sturgeon fishing guide business now established in Pool 25 at Clarksville, Missouri; the documentation of three of 15 radio and sonically tagged adult lake sturgeon moving through the flood gates of Dam 22 at Saverton, Missouri within a 12 month period; and the recapture of several lake sturgeon throughout the Missouri River that were initially released in the Missouri River at Herman.

It is possible that the more turbid conditions of the Missouri River would reduce predation, allowing increased survival of smaller fish. This would allow for lake sturgeon to be stocked at a smaller size. Stocking at a smaller size would more efficiently use hatchery space and allow for more fish to be stocked. Research comparing the survival of lake sturgeon stocked as 3- to 4-inch fish to the survival of 8- to 10-inch fish is needed on the Missouri River, or its large tributaries such as the Grand or the Osage rivers, to determine the extent to which fry or small fingerling stocking can be used in the future.

The lake sturgeon stocked prior to 2002 came from the Wolf River in Wisconsin, in the Lake Winnebago system (Great Lakes Basin). Beginning in 2002, the egg source has been the Wisconsin River, a tributary to the Mississippi River. Future stockings will be from eggs obtained by the Wisconsin Department of Natural Resources from the Mississippi River basin.

Beginning in 2002, lake sturgeon stocked into the Mississippi River had been raised at the Genoa National Fish Hatchery in Wisconsin. The Department supplied funds for their feed and transported them from the hatchery to the stocking sites. The federal hatchery supplied the hatchery space, labor, and tagging. Utilization of the federal hatchery system to augment implementation of this plan will ensure its completion.

If we make visual observations of spawning sturgeon or locate spawning sites using telemetry, we can use larval drift capture techniques (Auer and Baker 2002) to document spawning success. We need to develop a sampling regime that will adequately assess lake sturgeon population status in Missouri's big rivers. Standard index netting methods are used elsewhere (Haxton 2002) to determine lake sturgeon relative abundance and may be applied to this population. Implementing strategies to achieve this objective will move us closer to the goal of establishing a self-sustaining population of these fish in their native habitat and hopefully result in delisting them as state endangered.

- Strategy A: Continue stocking the Pool 24 site at Louisiana and the Pool 21 site at LaGrange on the Mississippi River, and stocking at three of the four previously established sites on the Missouri River in the vicinity of Washington, Hermann, and Waverly annually through 2016. Assuming up to 24,000 fish will be available annually, one half of the production should be stocked at the two sites on the upper Mississippi River and the remaining one half should be stocked in three of the four Missouri River sites. The stocking program may be suspended or modified prior to 2016 if significant spawning and recruitment is documented.
- Task 1: Arrange for up to 24,000 8- to 10-inch lake sturgeon to be stocked annually through 2016, when available.
- Task 2: Select Missouri River stocking sites near confluence with major tributary streams that might be used as future spawning areas.
- Strategy B: Make arrangements to obtain additional lake sturgeon eggs or fingerlings to meet the demand of increased stocking densities.
- Task 1: Complete a 10-year memorandum of understanding with the Wisconsin Department of Natural Resources by the end of 2007 to ensure a dependable source of lake sturgeon eggs.
- Task 2: Partner with the federal hatchery system to share lake sturgeon rearing duties to meet the additional demand necessary to implement this plan.
- Strategy C: Enable determination of year class relative abundance, origin, and growth.
- Task 1: Tag or mark all lake sturgeon with a distinct marker or tag prior to stocking for later identification.
- Strategy D: Evaluate the feasibility of fry/small fingerling stocking in the Missouri or Mississippi rivers or one of their large tributaries such as the Grand, Salt, or the Osage rivers.
- Task 1: Evaluate the lower reach of a major tributary stream as a potential site to investigate the feasibility of fry/small fingerling stocking. Chose one study site for evaluation by the end of 2007.
- Task 2: Working with sturgeon experts, establish an experimental design and conduct an evaluation of the survival of lake sturgeon stocked as 3-4 4-2 inch fish compared to the survival of 8-10 inch fish.
- Task 3. Integrate the results of the evaluation into lake sturgeon stocking plans at other lake sturgeon stocking sites as soon as practical.
- Strategy E: Provide for protection of stocked lake sturgeon to allow for growth and survival
- Task 1: Provide strict enforcement of sport and commercial fishing regulations in the Missouri and Mississippi rivers to protect lake sturgeon.



**Objective 1.2: Characterize and quantify lake sturgeon habitat in the Mississippi and Missouri rivers and selected tributary streams and recommend measures to protect and improve it by 2009.**

Rationale: According to the 1998 Status and Trends Report (U.S. Geological Survey 1999) water quality in the Upper Mississippi River has improved, in some ways, in recent decades. Gross pollution by sewage has been reduced, but the river continues to receive contaminants from agricultural, industrial, municipal, and residential sources. Poor water quality conditions are now mostly confined to specific locations that experience short-term degradation. However, contaminated sediments, especially in heavily populated areas, remain a long-term problem. Re-introduction efforts are based on the premise that water quality conditions are not a variable that threatens lake sturgeon survival and growth.

A review of literature and personal contacts with fisheries workers from northern states with viable lake sturgeon populations will help identify critical habitats.

Spawning habitat is characterized as having 1) proximity to deep overwintering pools, 2) extensive rocky substrate or shoreline cover, 3) clean substrate with clean interstitial spaces, and 4) sufficient velocity to keep the substrate and its interstitial spaces clean and incubating eggs aerated (Bruch and Binkowski 2002).

Nursery areas are located downstream of spawning areas. The distance corresponds to the distance traveled in the larval drift stage (Auer and Baker 2002). Juveniles tend to be generalists so areas with high invertebrate density will likely be utilized by that life stage. Juveniles are more likely to be found in areas of gradual slope with sand or sand and gravel substrate (Jackson *et al.* 2002). The lower reaches of major tributaries to the Missouri and Mississippi rivers might provide this critical habitat for young sturgeon. We suspect spawning may someday occur in larger tributaries such as the Des Moines, Fabius, Salt, Cuivre, Gasconade, Osage, Lamine, Grand, Kansas, and Platte rivers.

Preferred habitat of adult lake sturgeon depends on time of year. Fish old enough to spawn will stage in a deep area the fall prior to spawning, usually within about two miles of the spawning site, remain there during the winter, and move into the spawning site about two weeks prior to spawning in the spring (Bruch and Binkowski 2002). It is not known if those adults not actively spawning use the staging habitat. Spatial distribution was part of a study in the St. Clair River and Lake St. Clair, MI. Using setlines and trawling on a grid system, investigators learned that concentrations of larger fish were where the old natural channel of the river passed through the lake, in a depositional area (Thomas and Haas 2002). Gill net sets targeting lake sturgeon in Upper Mississippi River pools 21, 22, and 24 were most successful in eddies below wing dams or navigation dams. The substrate was sand, but covered with newly deposited organic debris (personal communication, Ken Brummett, 2003).

Resource managers need to be aware of characteristics of critical lake sturgeon habitat. As they review, design, or implement instream work, they should ensure the work will either be neutral or enhance lake sturgeon habitat. As new information and funding becomes available, resource managers should consider restoring critical lake sturgeon habitat.

- Strategy A: Identify, quantify, and document critical habitats for different life stages of lake sturgeon in Missouri's rivers.
- Task 1: Using telemetry and known spawning habitat characteristics, identify potential staging areas and spawning sites in the Mississippi and Missouri rivers and their major tributary streams by 2007.
- Task 2: Identify potential nursery habitats associated with those spawning habitats by 2007.
- Task 3: Using telemetry, identify critical adult lake sturgeon seasonal habitats by 2007.
- Task 4: Create a GIS coverage map of the Upper Mississippi River and Missouri River and their major tributaries that displays critical lake sturgeon habitat for all life stages by 2009.
- Task 5: Review project proposals submitted by federal, state, and private agencies and individuals that fall within known lake sturgeon range for potential to impact various life stages of the species, and seek opportunities to enhance or develop lake sturgeon habitat.
- Task 6: By 2011, develop and implement at least one lake sturgeon habitat project to enhance critical life stage habitat on the Mississippi or Missouri rivers. The initial project, possibly funded under the State Wildlife Grant program, could serve as a model for additional projects. Project evaluation will be included in its cost.

**Objective 1.3: Develop methods for describing a desirable lake sturgeon population in the Mississippi and Missouri rivers by 2011.**

Rationale: At present, there are no definitive criteria to describe a desirable lake sturgeon population. Two examples are found in the Wisconsin Lake Sturgeon Management Plan (Wisconsin Department of Natural Resources 2000) and the Menominee Reservation Sturgeon Restoration Plan (Runstrom *et al.* 2002). Both plans recommend sturgeon population characteristics, but current knowledge does not allow formulation of standardized population assessment criteria. Being able to capture sufficient numbers of fish to make a valid assessment of the population is a barrier to describing a desirable population. Considerable effort needs to be expended to determine how to sample lake sturgeon so that population assessment criteria can be established. Capture methods vary from gill netting (Jackson *et al.* 2002, Haxton 2002), trapnetting (Haxton 2002), trotlines and trawling (Carlson and Pflieger 1981, Thomas and Haas 2002), drift nets for larvae (Auer and Baker 2002), and electrofishing (personal communication, Ron Bruch, 2001). Success of these capture

methods varies with physical characteristics of the water body being sampled. Information required for development of a reliable method for describing a desirable lake sturgeon population includes growth rate, recruitment, relative abundance of individual year classes and size distribution, mortality rate, and age at maturity.

- Strategy A: Establish criteria for describing a desirable lake sturgeon population, identify best gear types for sampling, and develop standardized methods for sampling various sizes of lake sturgeon in the Mississippi and Missouri rivers by 2011.
- Task 1: Use available literature and past sampling efforts to evaluate the effectiveness of gill nets, trapnets, trotlines, trawling, and electrofishing for capturing lake sturgeon. Contact commercial fishers to determine gear types they believe are most effective at capturing lake sturgeon.
- Task 2: Initiate a stratified random sampling program making use of spatial and temporal strata. After two seasons, determine the most effective gear type(s) and optimum sampling period(s) to obtain an unbiased sample.
- Task 3: Initiate an aggressive sampling regime using the most effective methods at the best times to capture enough fish to describe the current status of the population in 2011.
- Task 4: By 2011, attempt to describe a desirable lake sturgeon population for the Mississippi and Missouri rivers based on results of the intensive sampling program.

**GOAL 2: Ensure public understanding of, appreciation of, and cooperation with the lake sturgeon recovery effort.**

**Objective 2.1: Secure support and coordination of other resource agencies within the Mississippi River Basin.**

Rationale: Successful recovery is dependent upon support and cooperation from states bordering the Mississippi and Missouri rivers because there is a high probability that many of the stocked sturgeon will move outside our state boundaries. We should ask resource agencies in those states to inform their general public about the protection required for lake sturgeon.

At present, Wisconsin regulations permit the harvest of lake sturgeon from selected inland and boundary waters, but not from the Mississippi River. Minnesota regulations permit harvest on its Ontario and Wisconsin boundary waters, but the rest of the state is closed to lake sturgeon harvest. Iowa and Illinois natural resource agencies list lake sturgeon as a threatened and endangered species, similar to Missouri's Species of Concern listing. Nebraska and Tennessee natural resource agencies list lake sturgeon as a protected species. Kentucky regulations prohibit commercial harvest of lake sturgeon, but do not mention the species in their sport fishing regulations. Kansas and Arkansas natural resource agencies do not mention lake sturgeon in their current fishing regulations. Mississippi and Louisiana natural resource

agencies do not list lake sturgeon as protected, but prohibit harvest of other sturgeon species.

Strategy A: Develop informational materials to inform the state fisheries agency of all states bordering the Mississippi River and the Missouri River below Gavin's Point Dam, South Dakota, about Missouri's lake sturgeon recovery program. Seek their cooperation in informing their public, promoting the values of lake sturgeon, and reporting lake sturgeon captures.

Task 1: By 2007 make the goals of Missouri's lake sturgeon recovery program known to the state fisheries agency of the above states.

Task 2: By 2008 prepare a short, concise article that explains Missouri's lake sturgeon recovery efforts, promotes lake sturgeon, asks the general public to report all sightings, and submit the article for publication in each state's monthly resource magazine.

Strategy B: Encourage the above states not currently listing lake sturgeon in their sport or commercial regulations to add the species and, where appropriate, restrict their harvest.

Task 1: By 2007, contact the state fisheries agency in the states listed in Strategy B and ask them to initiate the process of listing lake sturgeon as a protected species in their sport and commercial fishing regulations.

**Objective 2.2: Encourage proper identification of lake sturgeon by commercial fishers and their reporting of lake sturgeon caught and released.**

Rationale: Cooperation of Missouri's commercial fishers is extremely important for a successful lake sturgeon recovery effort. The best opportunity to receive reports of lake sturgeon captures will be from commercial fishers because most of them use gear that readily captures sturgeon. It is important that commercial fishers distinguish between lake sturgeon and the other sturgeon species and that all captured lake sturgeon are quickly released in good condition. A strong effort should be made to gain full support of the lake sturgeon recovery program with all commercial fishers.

Strategy A: Provide information to all licensed commercial fishers in Missouri and bordering states about Missouri's lake sturgeon recovery program.

Task 1: By 2007, provide an update on Missouri's lake sturgeon re-introduction efforts to all licensed commercial fishers in Missouri and bordering states, including a key to help identify lake sturgeon and explain the importance of releasing all lake sturgeon accidentally captured.

Task 2: By 2007, add a location on the monthly commercial fishing report form to allow them to voluntarily log protected sturgeon species catch by date and nearest river mile location.

**GOAL 3:** Establish a lake sturgeon population than can support a unique sport fishing opportunity.

**Objective 3.1:** Manage lake sturgeon to delist them as state endangered species with evidence of adequate recruitment and when 15-20% of the population is 50 inches or longer.

Rationale: The logical sequence of events to establish a sport fishery would be: 1) to delist the species based on sampling data, 2) continue to allow a catch and release fishery (anglers should encounter lake sturgeon more often as the population grows in number and older individuals are more common), and 3) recommend that the Commission allow an extremely regulated harvest for recreational anglers. The time between these waypoints is difficult to predict.

If the population continues to grow, the Missouri Department of Conservation must coordinate efforts to delist lake sturgeon in Missouri. Criteria for delisting lake sturgeon in Missouri would probably be based on: catch rates or population estimates, widespread occurrence in the pooled portion of the Mississippi River and in Missouri River, evidence of consistent reproductive success, and the proportion of the population that is sexually mature. Other population rate functions may be used as well. We do not know what criteria other states would use.

Theoretically the lake sturgeon population should be able to support a limited sport harvest when 10 to 15% of the population is sexually mature. This level of maturity should exist when 15 to 20% of the population is 50 inches or longer. Because lake sturgeon grow slowly and mature at an advanced age, these conditions will not be attained quickly. Realistically, if we can get to the catch and release stage by 2016, it will be considered a major accomplishment.

**Strategy A:** Use lake sturgeon population characteristics derived from intensive sampling to model the population and determine acceptable angler mortality levels and recommend appropriate harvest regulations.

**Task 1:** Use annual population sampling data to determine sex ratio, relative abundance, sizes, and age structure of the populations.

**Task 2:** Delist lake sturgeon the protected list of Missouri fishes if population characteristics are sufficient.

**Task 3:** Coordinate with natural resource agencies of other states to suggest removal of lake sturgeon from their protected status.

**Task 4:** Propose suitable harvest regulations when the criteria for allowing catch and release fishing and/or sport harvest are met.

**Objective 3.2:** Promote the lake sturgeon's unique sportfishing potential to Missouri's big river anglers and inform them of recovery efforts.

Rationale: The success of Missouri's lake sturgeon recovery program requires the support of the big river users. It is important that the big river users and supporters be aware that the recovery program includes not only protection of the fish, but also habitat improvement and support for regulations, and that the ultimate goal is to provide a lake sturgeon sport fishery.

Strategy A: Inform anglers in counties adjoining the Missouri and Mississippi rivers about the lake sturgeon sportfishing potential and recovery efforts.

Task 1: By 2007, inform Missouri's big river users about lake sturgeon restoration by placing posters at strategic locations such as fish markets, bait shops, and at all Missouri Department of Conservation access sites on the Mississippi and Missouri rivers and their major tributaries, and by using Missouri Conservationist articles, newspaper articles, and radio and television spots.

Task 2: When lake sturgeon population levels and regulations allow, promote lake sturgeon sportfishing through local media, Missouri Conservationist articles and MDC radio and television shows.

#### **IV. SUMMARY**

The mission of the lake sturgeon recovery program is to improve populations of a state endangered species, and increase the sturgeon's numbers sufficiently to provide a unique sport fishing opportunity to Missouri anglers. The goals, objectives, and strategies outlined in this plan provide a framework to guide Missouri's lake sturgeon management and culture efforts. This plan also serves as a tool to help communicate recovery program direction to anglers.

The successful establishment of Missouri's lake sturgeon recovery program from its beginning several decades ago to the present can largely be attributed to the cooperative efforts of hatchery, fisheries management and research personnel of the Missouri Department of Conservation, a generous supply of eggs collected from wild fish by the Wisconsin Department of Natural Resources, the assistance of the US Fish and Wildlife Service (especially the staff at Genoa National Fish Hatchery) and the help of sport and commercial anglers carefully releasing the stocked lake sturgeon. The future success of lake sturgeon will continue to rely on these committed and interested parties.



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### IMPLEMENTATION SCHEDULE

Obj.	Strategy	Task	Task Description	Lead	Initiation Of Task	FTE In Days	Task Cost
1.1	A	1	Request fingerling stockings for Mississippi River	Mgt.	2007	0.5 d/yr	
	B	1	Select stocking locations for Missouri River	Mgt.	2007	1	
		2	Request fingerling stockings for Missouri River	Mgt.	2007	0.5 d/yr	
	C	1	Develop 10-yr. MOA with Wisconsin DNR	Admin.	2007	4	
		2	Partner with federal hatchery system to meet needs	Hatch.	2007	0.5 d/yr	
	D	1	Mark all stocked fingerlings	Mgt.	2007	?	
1.2	A	1	Identify potential staging and spawning sites using radio telemetry	Mgt.	2007 in prog.	130	\$20,000/yr four to six years
		2	Identify potential nursery areas	Mgt.	2007 in prog.	see line above	see line above
		3	Identify critical adult habitats	Mgt.	2007 in prog.	see line above	see line above
		4	Create GIS map of critical habitats for all life stages	Mgt.	2009	65	\$10,000
		5	Review project proposals for opportunities to develop or enhance habitat	Mgt.	2009	2	
		6	Develop and implement one habitat project.	Mgt.	2011	20	\$100,000
1.3	A	1	Evaluate gear types for efficiency	Mgt.	2007 in prog.	130	\$20,000/yr four years
		2	Initiate a stratified random sampling program	Mgt.	2009	10	
		3	Initiate an intensive sampling regime	Mgt.	2011	20	
		4	Describe a desirable lake sturgeon population	Mgt.	2011	5	

2.1	A	1	Update other states on Project.	Mgt& Admin.	2007	3	
		2	Prepare article for each State's monthly magazine	Mgt.	2008	3	
	B	1	Contact basin states not currently protecting lake sturgeon and request they do so.	Admin.	2007	3	
2.2	A	1	Provide an update of project for commercial fishers in Missouri and other states	Admin.	2007	3	
		2	Request that commercial fishers voluntarily log protected sturgeon catch	Admin.	2007	see line above	
2.3	A	1	POS survey of sturgeon awareness.	RS	2009	3	
		2	Inform Missouri's citizens of lake sturgeon project.	Admin.	2007	3	
		3	Conduct awareness survey	RS	2010	20	
3.1	A	1	Determine condition of lake sturgeon population.	Mgt.	2013	20	
		2	Establish harvest goals, Seasons, sizes, and limits.	Mgt./RS	2016	10	
		3	Delist lake sturgeon if population condition warrants.	Admin.	2015	10	
		4	Request other states remove protected status.	Admin.	2015	3	